

L Number	Hits	Search Text	DB	Time stamp
1	102	IPVD or (ionized adj physical adj vapor adj deposition)	USPAT; US-PGPUB	2003/04/05 14:09
2	58	(IPVD or (ionized adj physical adj vapor adj deposition)) and titanium	USPAT; US-PGPUB	2003/04/05 14:53

	U	1 [1 ]	Document ID	Issue Date	Pages
1	<input type="checkbox"/>	<input checked="" type="checkbox"/>	US 20030059538 A1	20030327	18
2	<input type="checkbox"/>	<input checked="" type="checkbox"/>	US 20030057527 A1	20030327	16
3	<input type="checkbox"/>	<input checked="" type="checkbox"/>	US 20030003652 A1	20030102	12
4	<input type="checkbox"/>	<input checked="" type="checkbox"/>	US 20020137338 A1	20020926	7
5	<input type="checkbox"/>	<input checked="" type="checkbox"/>	US 20020132474 A1	20020919	12

	Title	Current OR	Current XRef
1	Integration of barrier layer and seed layer	427/304	427/123; 427/248.1; 427/255.28; 427/402
2	Integration of barrier layer and seed layer	257/642	
3	Method and installation for fabricating one-sided buried straps	438/243	438/386
4	Method for depositing copper films having controlled morphology and semiconductor wafers produced thereby	438/687	257/750; 257/753; 428/620; 428/647; 428/649; 428/652; 438/654; 438/658; 438/680
5	Barrier-metal-free copper damascene technology using atomic hydrogen enhanced reflow	438/643	257/750; 257/751; 257/752; 438/632; 438/638; 438/639; 438/646; 438/775

	Retrieval Classif	Inventor	S	C	P	2	3	4	5
1		Chung, Hua et al.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
2		Chung, Hua et al.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
3		Gobel, Bernd et al.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
4		Yasar, Tugrul et al.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
5		Ahn, Kie Y. et al.	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

US-PAT-NO: 5990004

DOCUMENT-IDENTIFIER: US 5990004 A

TITLE: Method for forming a tungsten plug  
and a barrier layer in a contact of high aspect ratio

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To increase the ohmic contact between the barrier layer and the silicon containing layer, a Ti layer is frequently deposited between the silicon containing layer and the TiN layer. The TiN layer is used as a barrier layer between a metal layer and a silicon containing layer. When forming a plug in a contact, the barrier layer is usually used to prevent the spike produced at the interface of the plug (usually formed of metal tungsten or aluminum) and the silicon containing layer. The TiN (titanium nitride) is usually used to form the barrier layer mentioned above. So the Ti layer together with the TiN layer is frequently used before the deposition of plug or interconnection.

First, use a physical vapor deposition to form a titanium layer on a topography of the semiconductor wafer to increase the ohmic contact to the exposed silicon contained layer. Thus a first portion of the titanium layer is formed on the dielectric layer, and a second portion of the titanium layer is formed on the exposed silicon contained layer. Next, remove the first portion of the titanium layer to expose the dielectric layer. Finally, use a chemical vapor deposition (CVD) method to form the barrier layer on the dielectric layer

and the first portion of the titanium layer to prevent said silicon contained layer from exposure.

FIG. 3 shows a cross sectional view of a semiconductor wafer after forming the barrier layer on the bottom of the contact, in addition, the WF.sub.6 reacts with the substrate and the exposed titanium layer, a worm hole is formed thereof;

forming a titanium layer on said dielectric layer and said exposed silicon contained layer, a first portion of said titanium layer being on said dielectric layer, a second portion of said titanium layer being on said exposed silicon contained layer, due to an aspect ratio of said contact opening, when forming said titanium layer, said second portion of said titanium layer at a center of said contact opening being thicker than said second portion of said titanium layer at a corner of said contact opening;

removing said first portion of said titanium layer;

forming a barrier layer on said dielectric layer and said second portion of said titanium layer by a chemical vapor deposition (CVD), said barrier layer being formed by said chemical vapor deposition using a material as a source, said material can be chosen from the group consisting of: TiCl<sub>3</sub>, NH<sub>3</sub> and TDMAT and TDEAT, said titanium layer being formed other than said chemical vapor deposition; and

forming said tungsten plug in said contact opening using a WF.sub.6, said barrier layer being used for preventing said WF.sub.6 from reacting with said titanium layer and said silicon contained layer.

3. The method as claim 1, wherein said titanium layer

is formed by an  
ionized physical vapor deposition (ionized PVD).

4. The method as claim 1, wherein said titanium layer is formed by a physical vapor deposition using a collimator.

5. The method as claim 1, wherein said barrier layer is a titanium nitride (TiN) layer.

L Number	Hits	Search Text	DB	Time stamp
1	1	("6168690").PN.	USPAT; US-PGPUB	2003/04/05 16:21
3	58	IPVD or (ionized adj physical adj vapor adj deposition) same (aspect adj ratio)	USPAT; US-PGPUB	2003/04/05 16:41
4	55	IPVD or (ionized adj physical adj vapor adj deposition) with (aspect adj ratio)	USPAT; US-PGPUB	2003/04/05 16:41
2	83	IPVD or (ionized adj physical adj vapor adj deposition) and (aspect adj ratio)	USPAT; US-PGPUB	2003/04/05 16:57